Improving Emission Estimates Through Regional Studies

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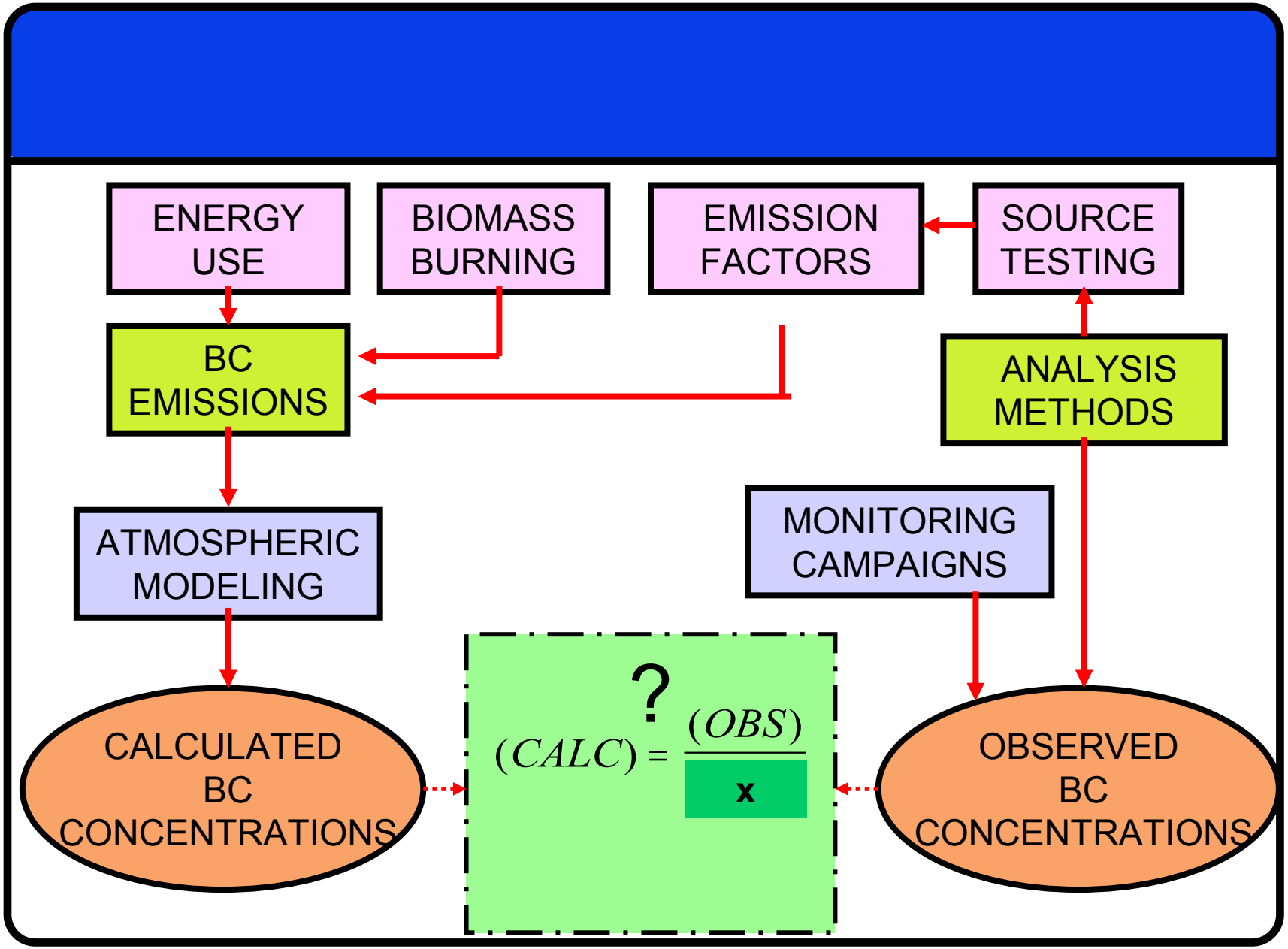
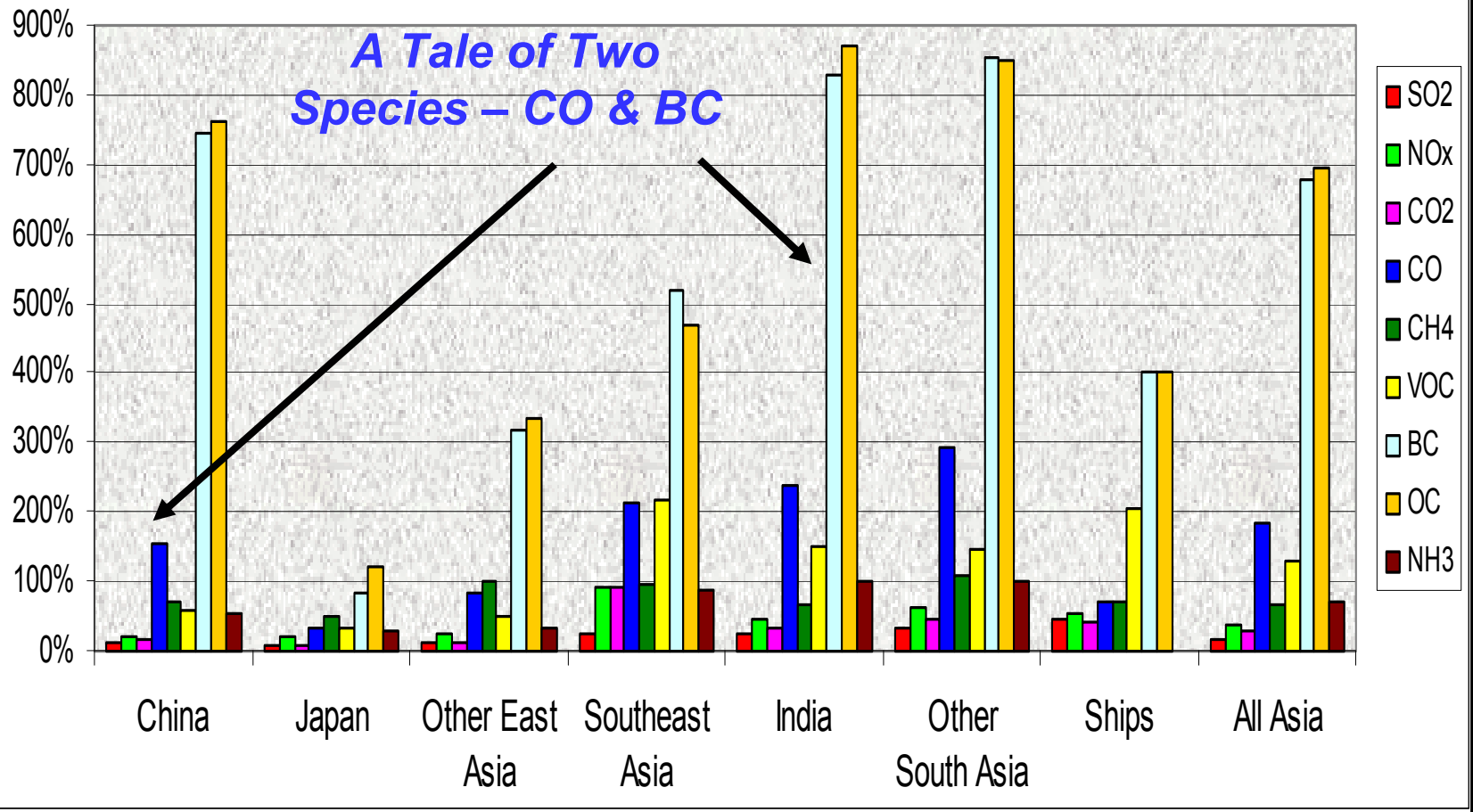
University of Iowa

and a cast of MANY

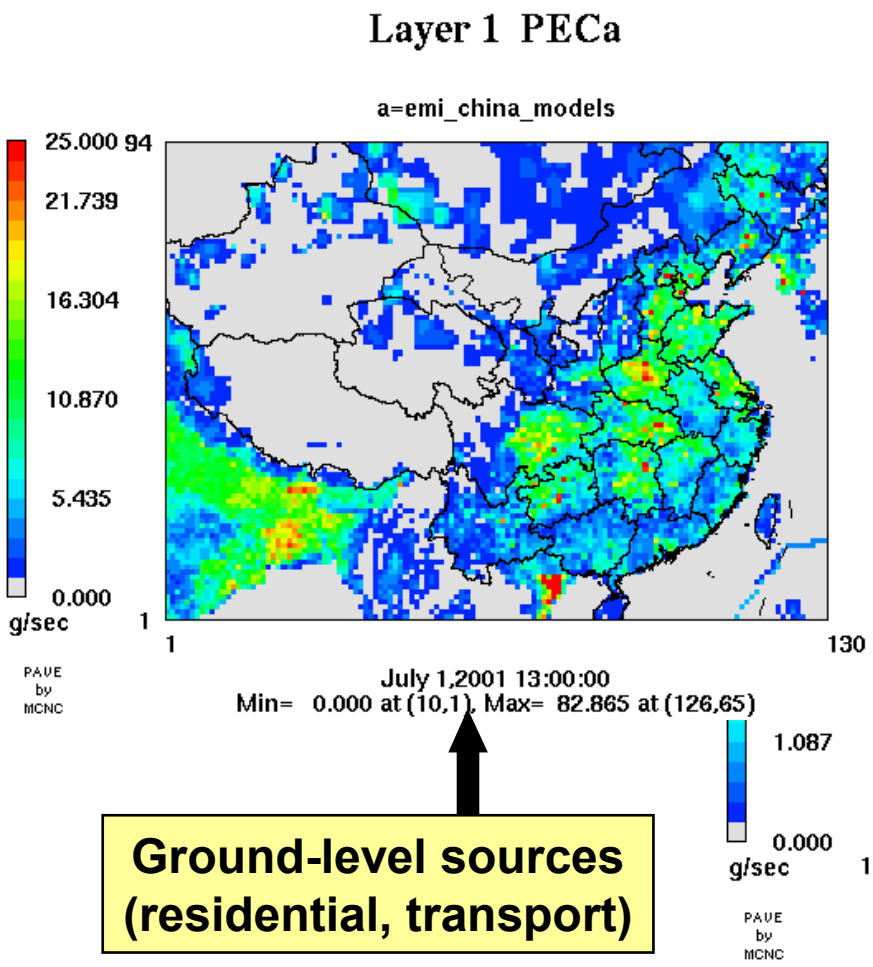

ENERGY USE
BIOMASS BURNING
EMISSION FACTORS
SOURCE TESTING
BC EMISSIONS
ANALYSIS METHODS
ATMOSPHERIC MODELING
MONITORING CAMPAIGNS
CALCULATED BC CONCENTRATIONS
?
(CALC) = (OBS) / x
OBSERVED BC CONCENTRATIONS

Un



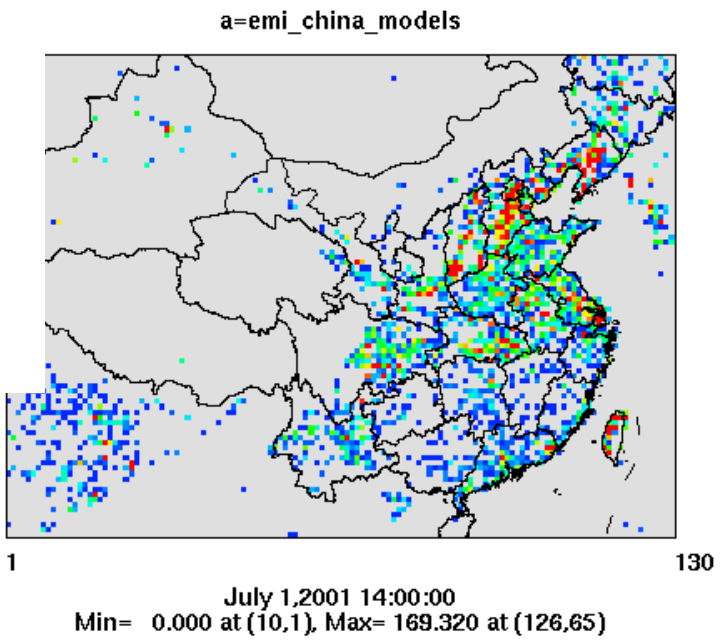
Streets et al., JGR

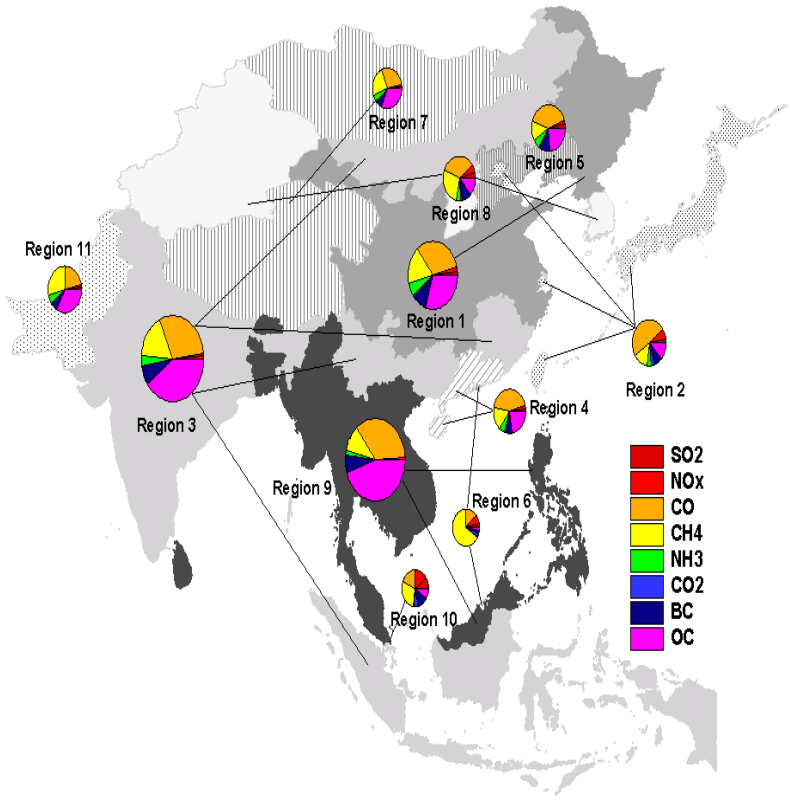
burning …

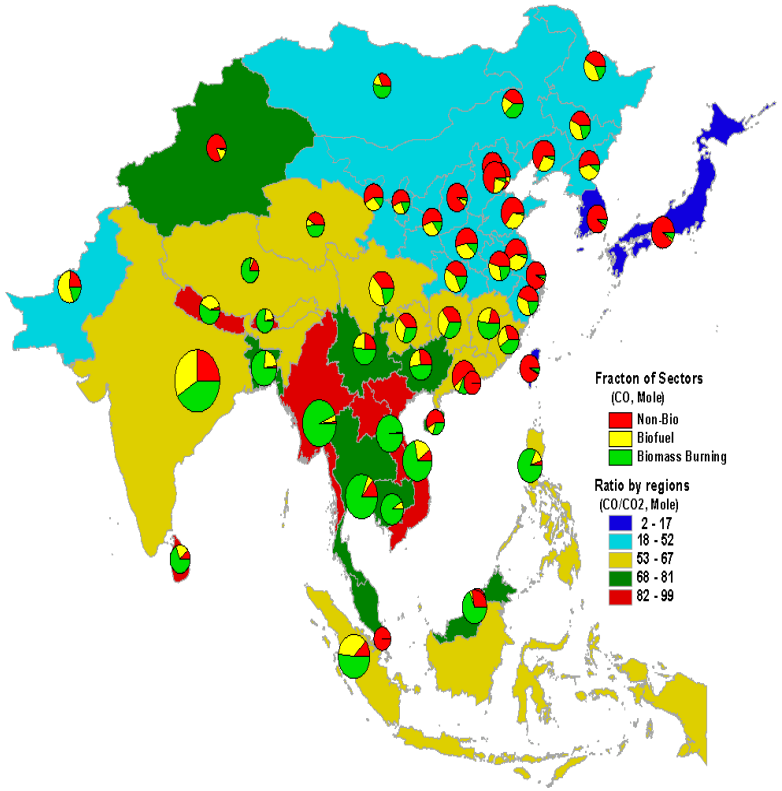


Second-layer sources (industry)

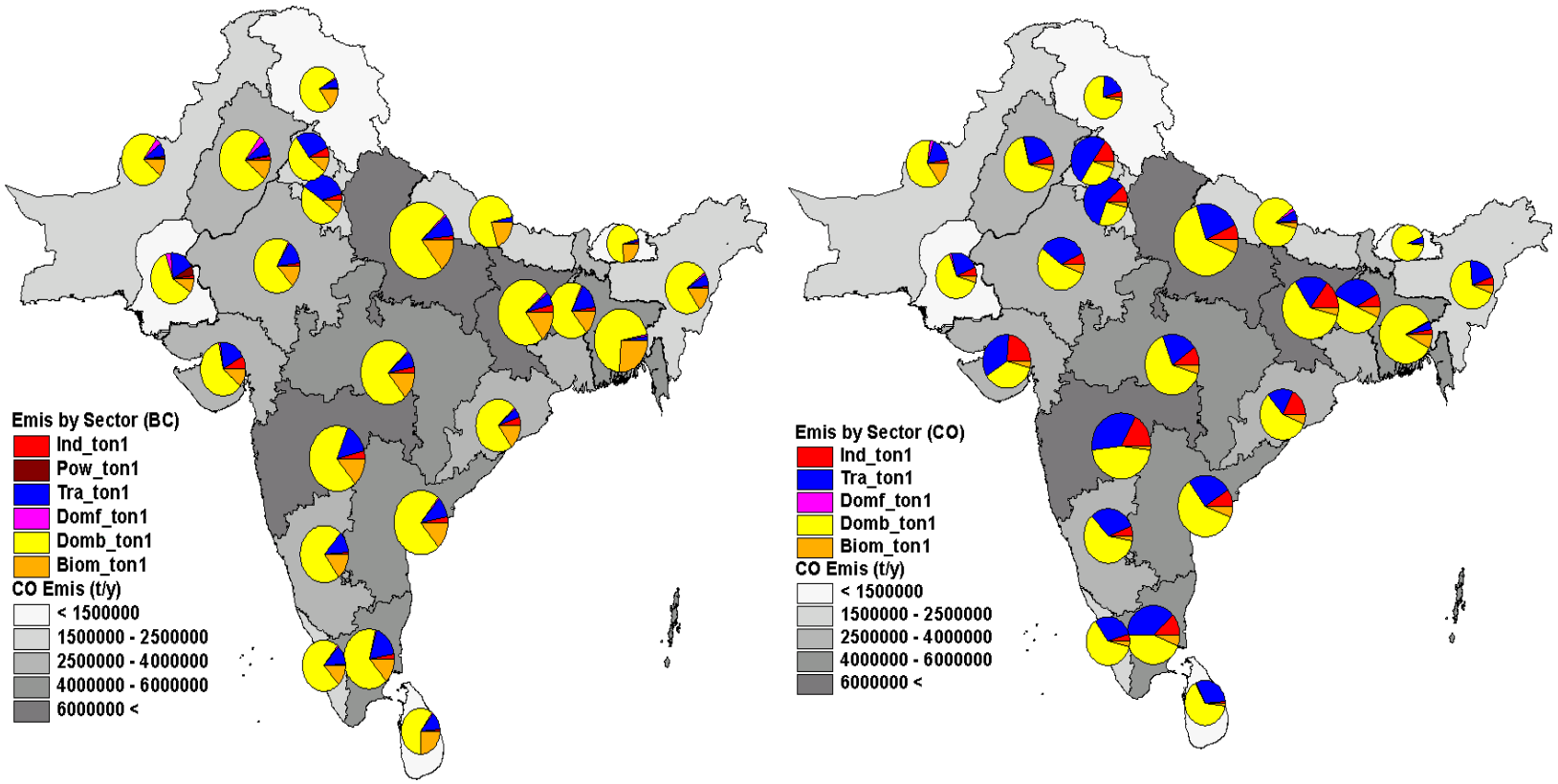
Ground-level sources (residential, transport)



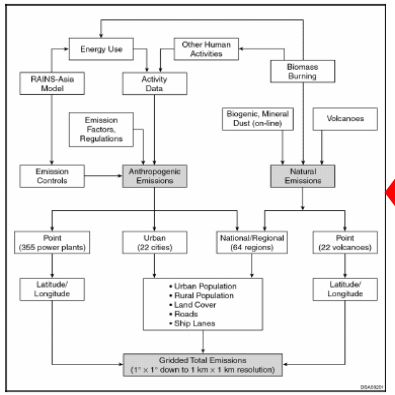




Woo et al., JGR, 2003



Streets et al., 2002



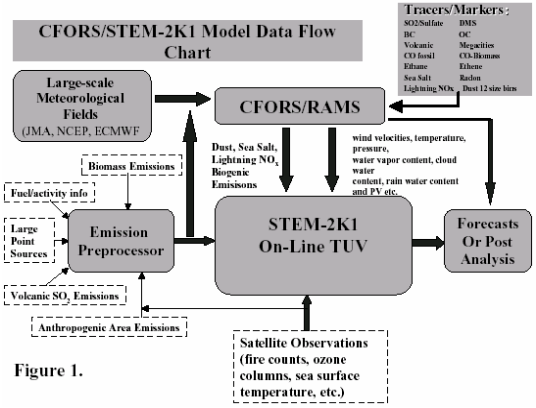
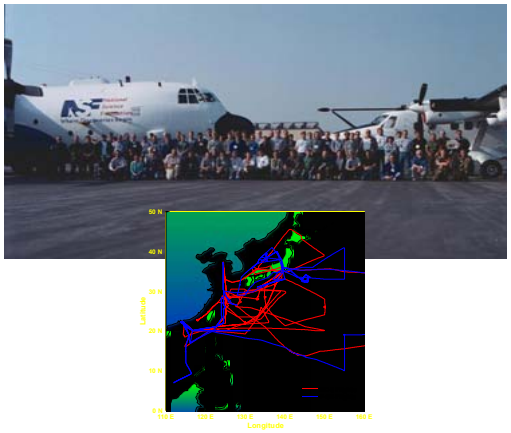
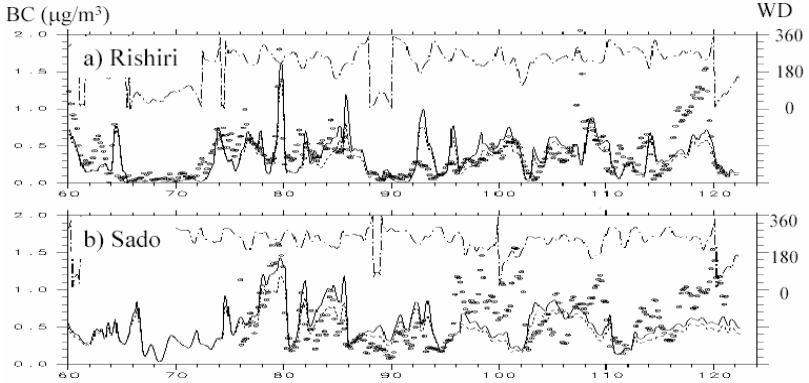


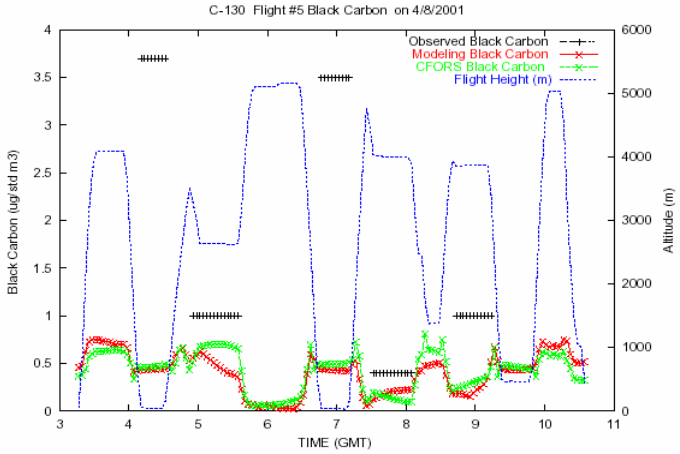
Figure 1.



Surface



Aircraft



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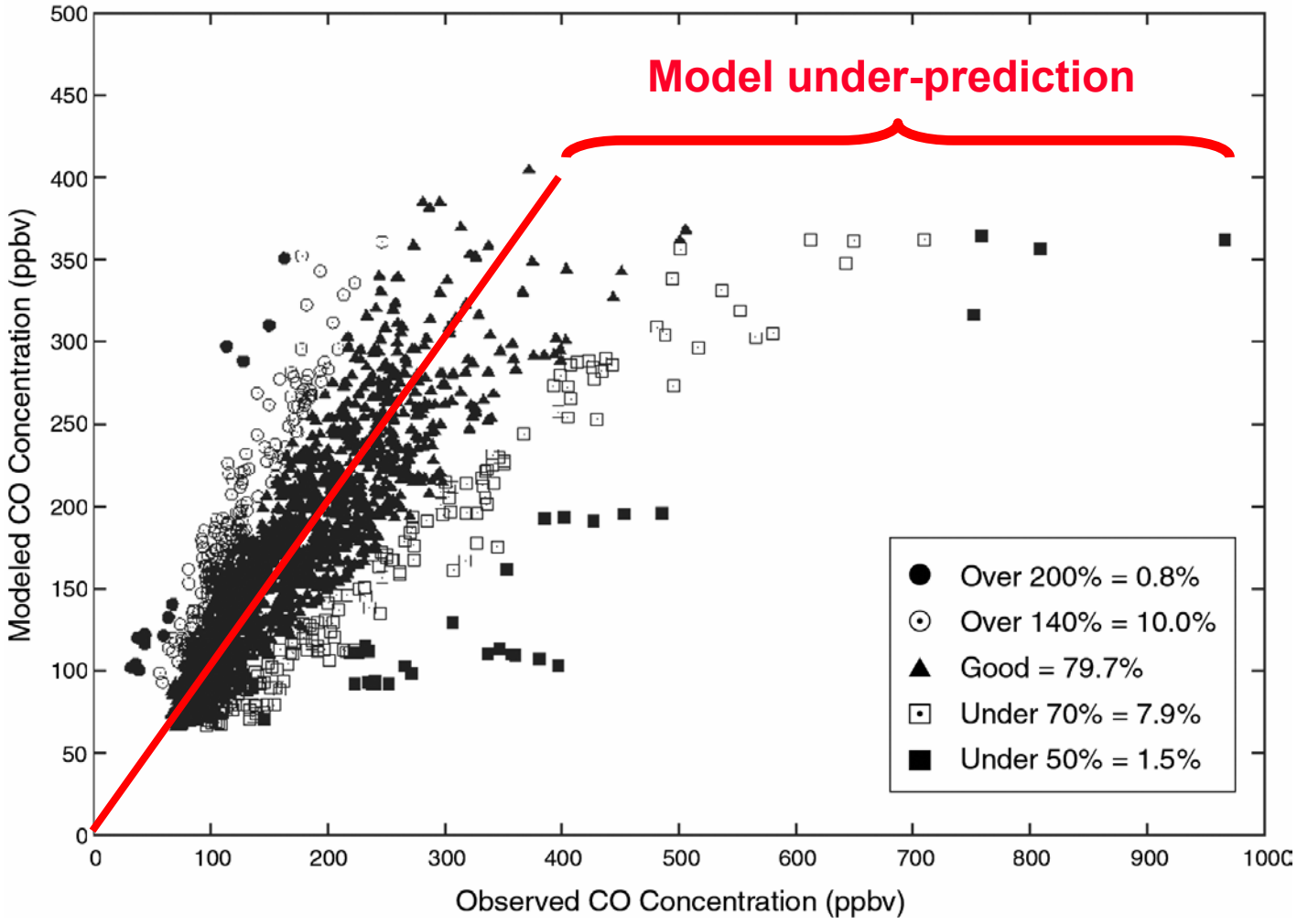
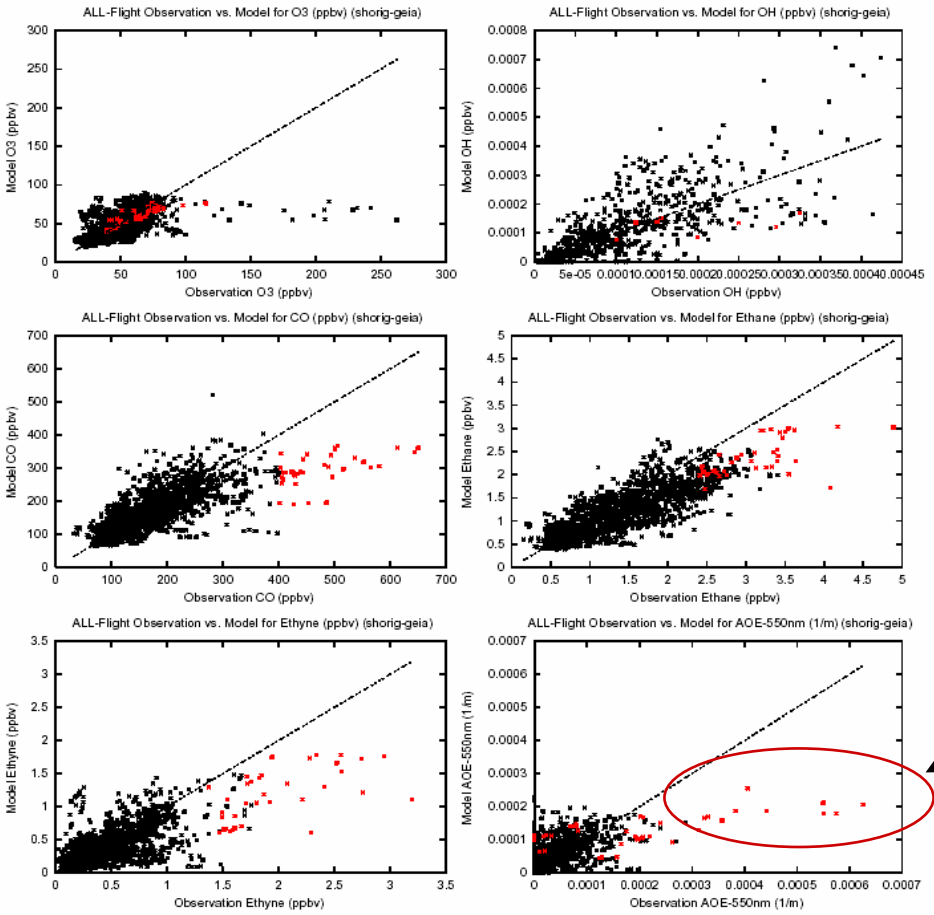

Model under-prediction
Modeled CO Concentration (ppbv)
Observed CO Concentration (ppbv)
0
50
100
150
200
250
300
350
400
450
500
0
100
200
300
400
500
600
700
800
900
1000
Over 200% = 0.8%
Over 140% = 10.0%
Good = 79.7%
Under 70% = 7.9%
Under 50% = 1.5%



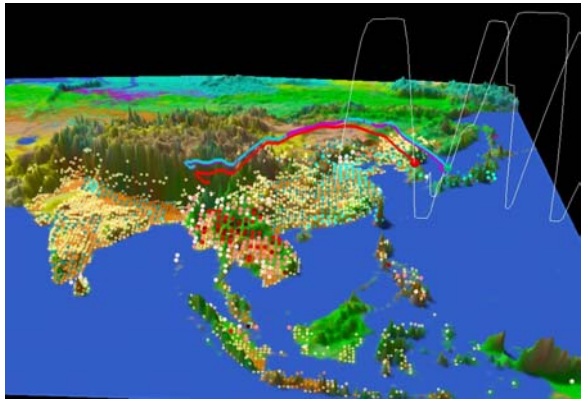
What does this tell us?

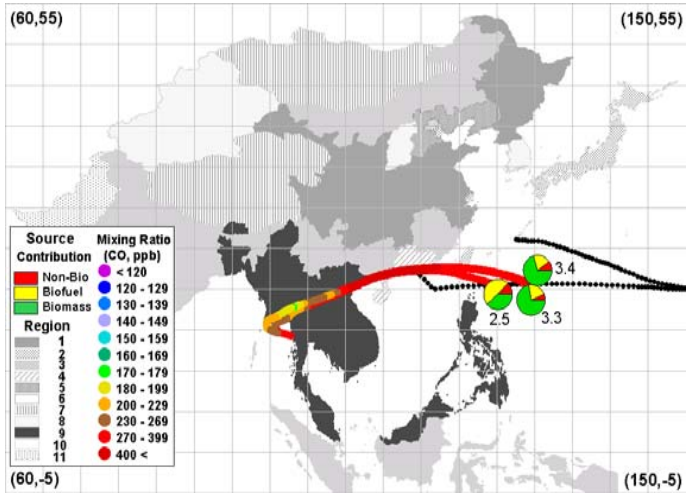
–

Model deficiency?

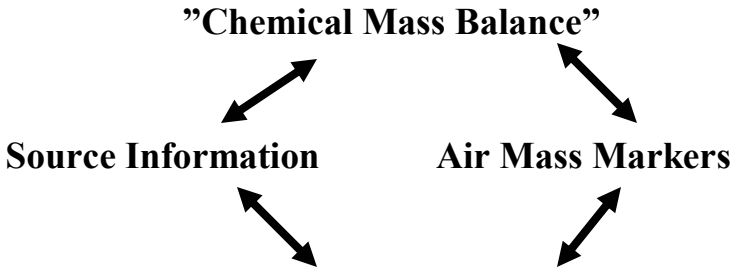
Emissions problem?

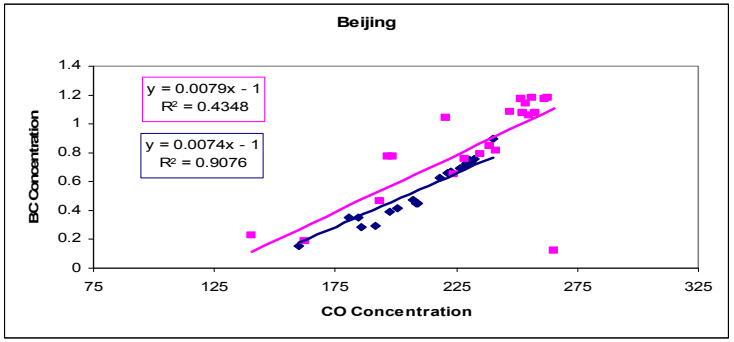
extinction



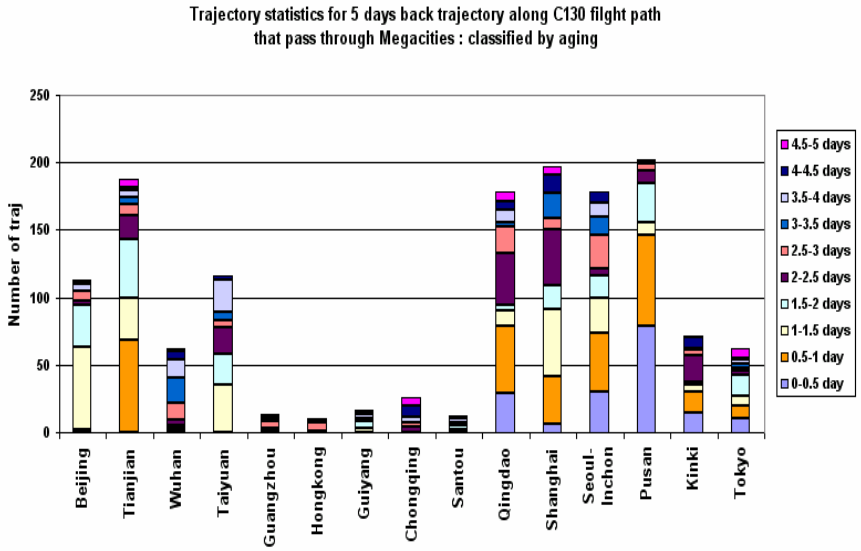


The Informatics Problem:



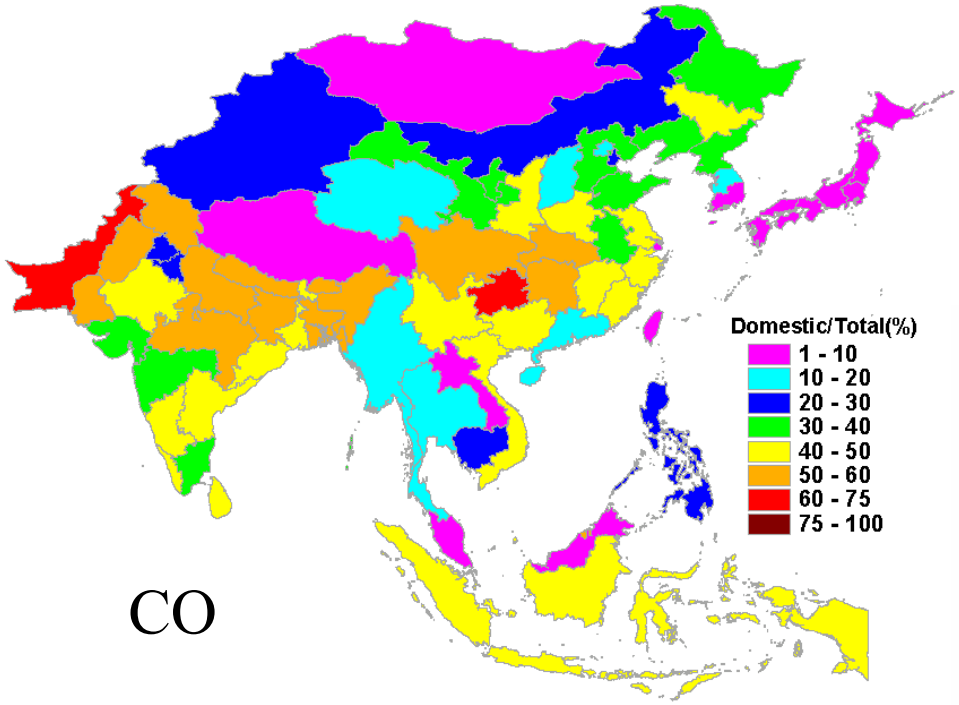


ΔBC/ΔCO		Ratio	R-square
Shanghai	Obs	0.0107	0.9556
	Model	0.0092	0.8772
	Emission	0.0083	
Tianjian	Obs	0.0102	0.8266
	Model	0.0084	0.6412
	Emission	0.014	
Tokyo	Obs	0.0226	0.8793
	Model	0.0205	0.9412
	Emission	0.0193	
Pusan	Obs	-0.016	0.06351
	Model	0.0072	0.3258
	Emission	0.0159	
Qingdao	Obs	0.0186	0.02618
	Model	0.0076	0.7707
	Emission	0.0148	



This analysis suggests directions to look for improvements

Is it the Domestic Sector?



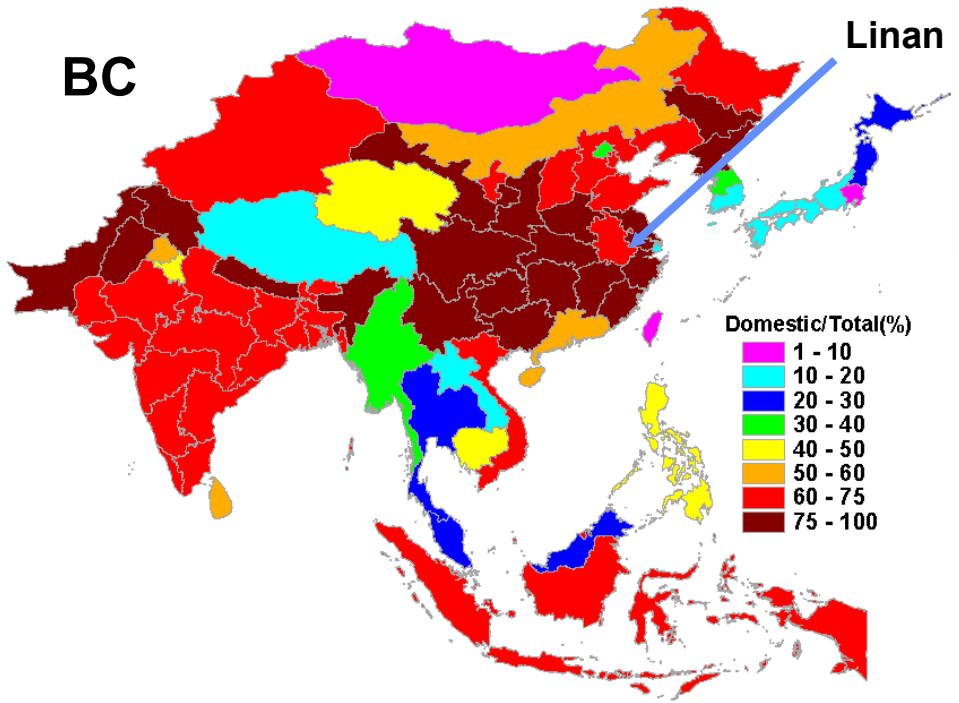
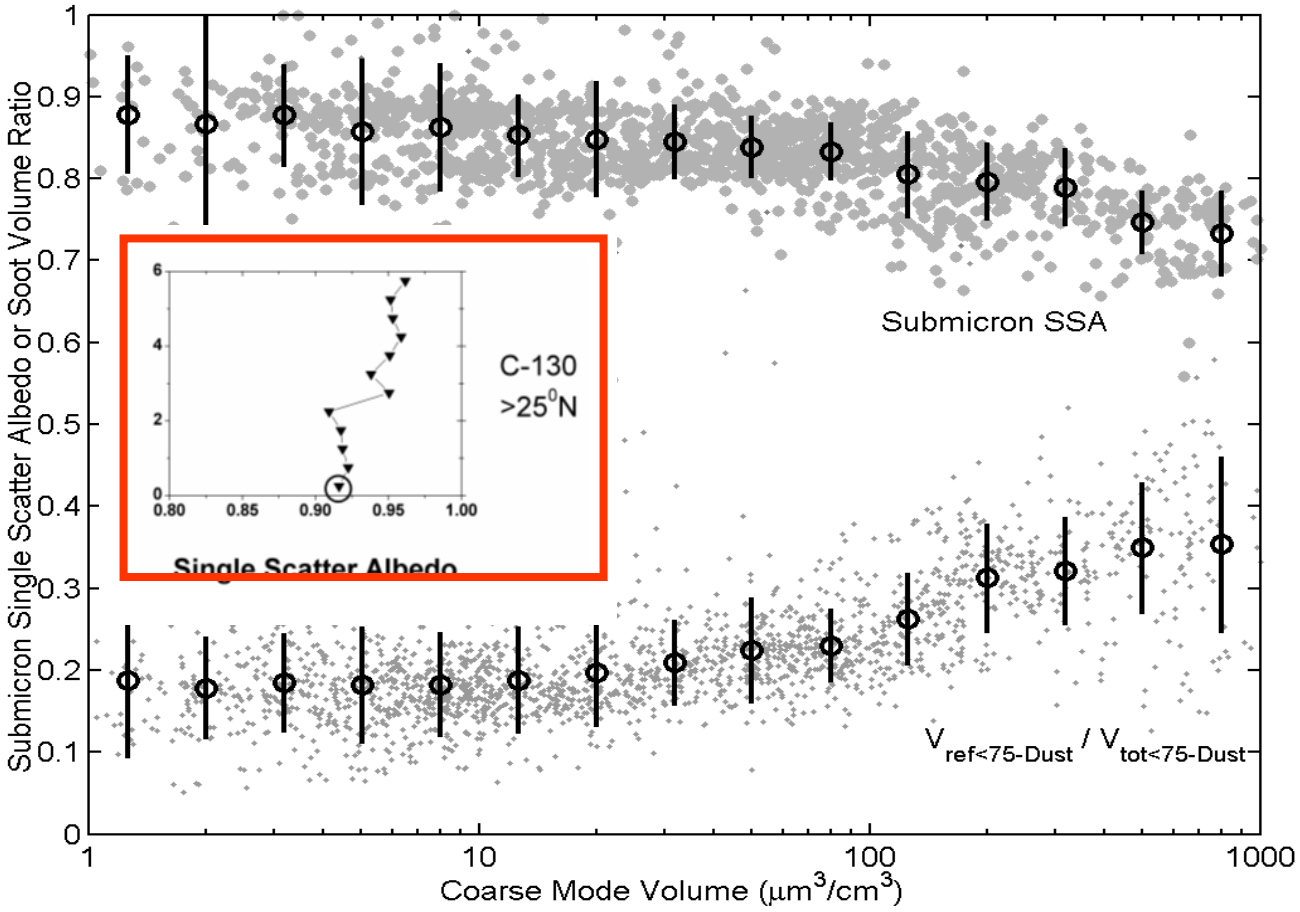


Table 4. Domestic sector emissions by fuel for 2000 (annual basis).

Chemical Species	Domestic sector			% of Domestic to Total Emisisons
	Fossil	Biofuel	Sum	
SO_2(Gg)	2549	1116	3665	11
NO_x(Gg)	795	1098	1894	7
CO(Gg)	8899	95721	104621	38
CO_2(Tg)	552	2132	2685	27
BC(Gg)	337	1294	1631	64
OC(Gg)	273	6473	6746	65

Table 3. Linan data

Species and Variables	Observed
CO (ppbv)	649.26
SO2 (ppbv)	16.49
NOy (ppbv)	13.24
BC (μg/m3)	3.5
OC (μg/m3)	44



Clarke et al., (in press)

New methodology and data

New methodology for industry, domestic and transport sector

New available activity data for 2001

Link with Control Strategy

Need to know the detail within sectors

Information from chemical modeling results

Inverse studies (using surface, aircraft data, and satellite data) for CO showing a ~40% Underestimation of Current Estimates

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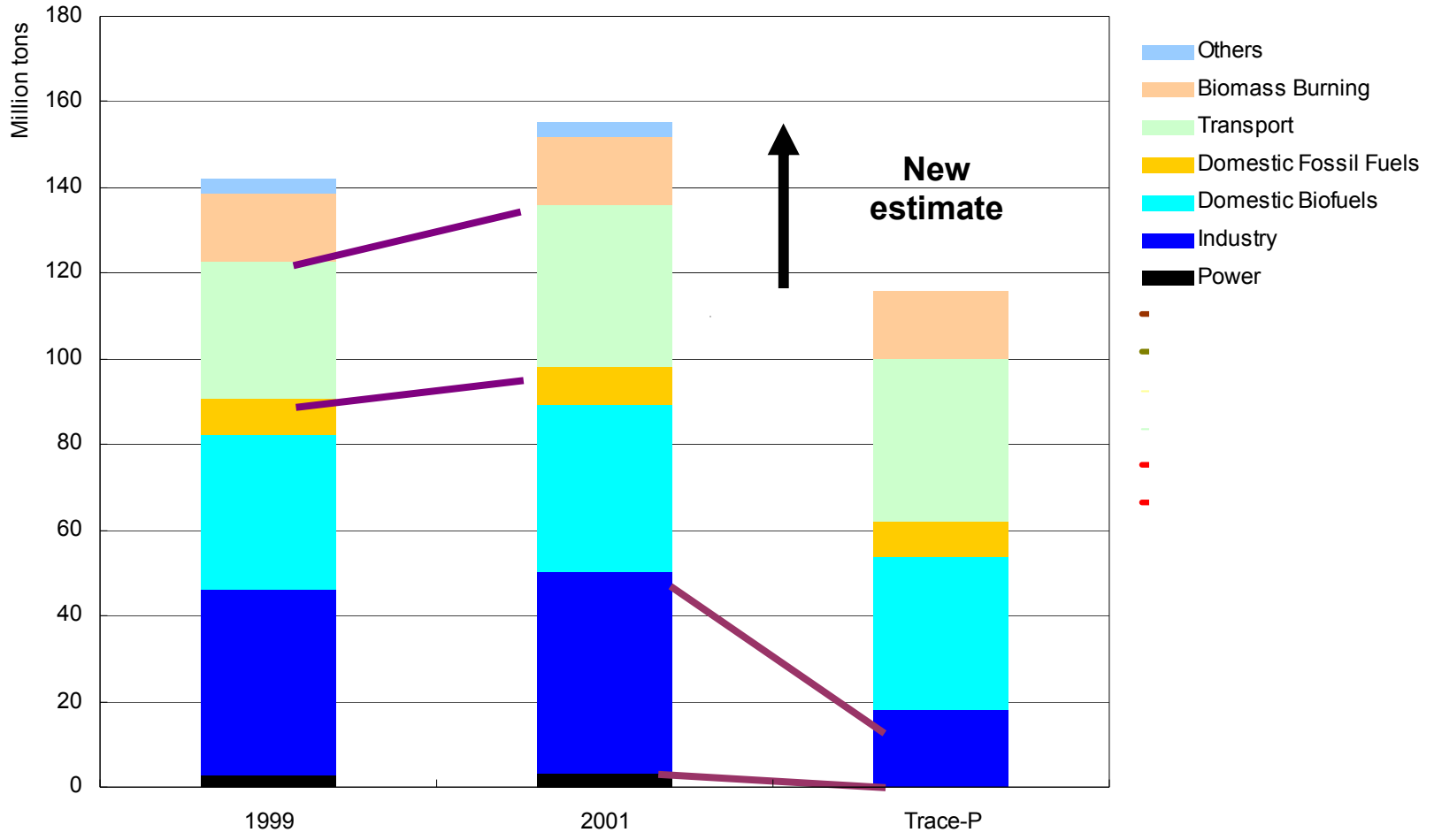
Q. Zhang[1], L. Wang[1], D. Streets[2], J. Fu[3], J.Woo[4]

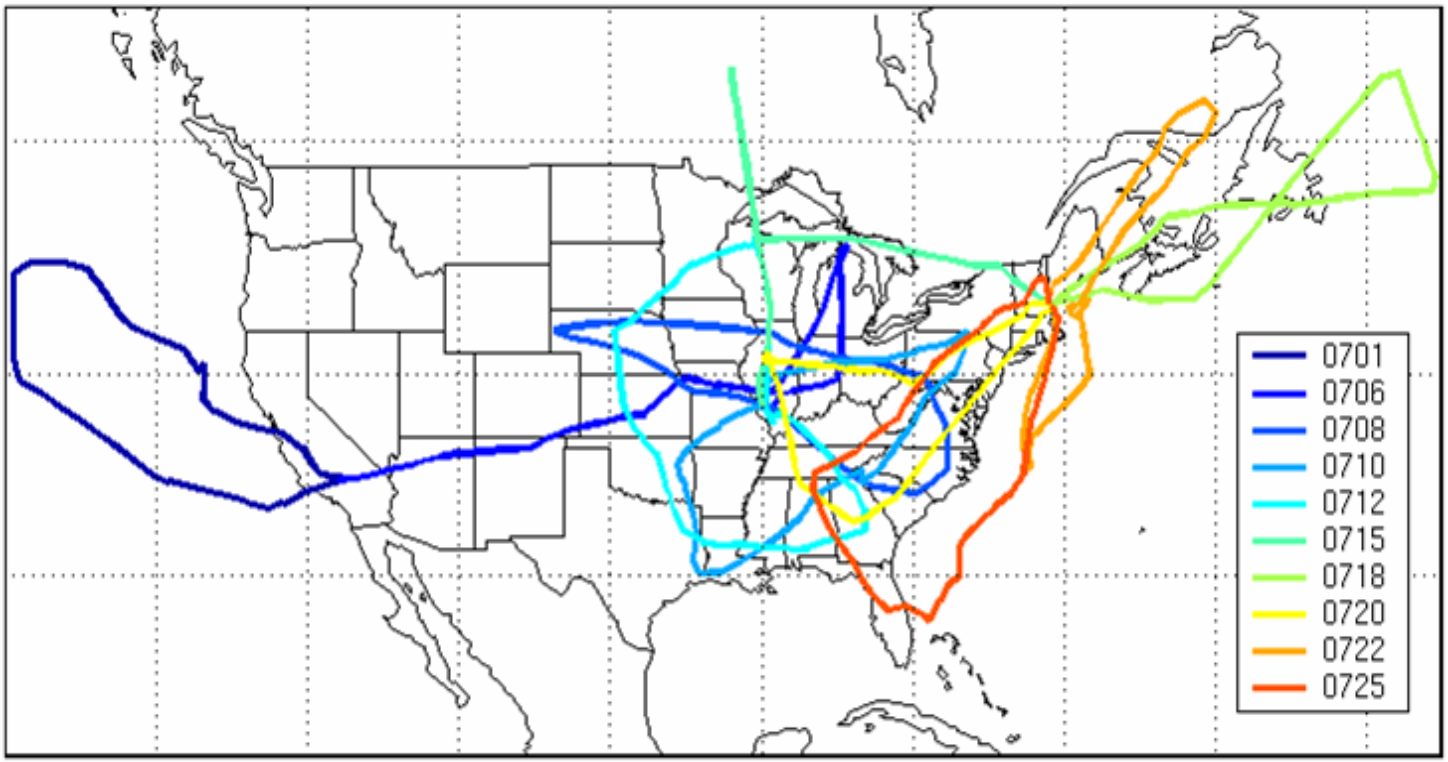
[1]Tsinghua University, Beijing, China
[2]Argonne National Laboratory, Chicago, USA
[3]Uinversity of Tennessee, Knoxville, USA
[4]Northeast States for Coordinated Air Use Management, Boston, USA

- **Small Coal Mines and Small Industries**
  - 170 Million tons difference between coal supply and coal consumptions
- **Efficiency of Combustion Device**
  - Which impact BC, OC, CO and VOC emissions
  - Important for control potential


Million tons
180
160
140
120
100
80
60
40
20
0
1999
2001
Trace-P
New estimate
Others
Biomass Burning
Transport
Domestic Fossil Fuels
Domestic Biofuels
Industry
Power

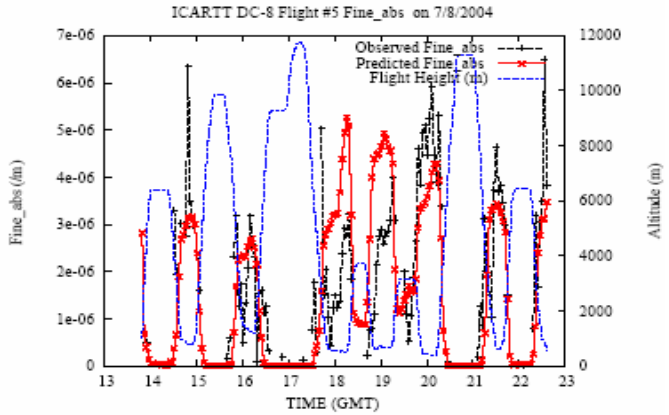
- **34% higher compared with Trace-P inventory**
- **73% of increase comes from industrial sector**
- **Key reason: low combustion efficiency**
- **Results in a ‘consistent‘ regional changes**
- **Implications for BC, OC and VOC? – *the next step***

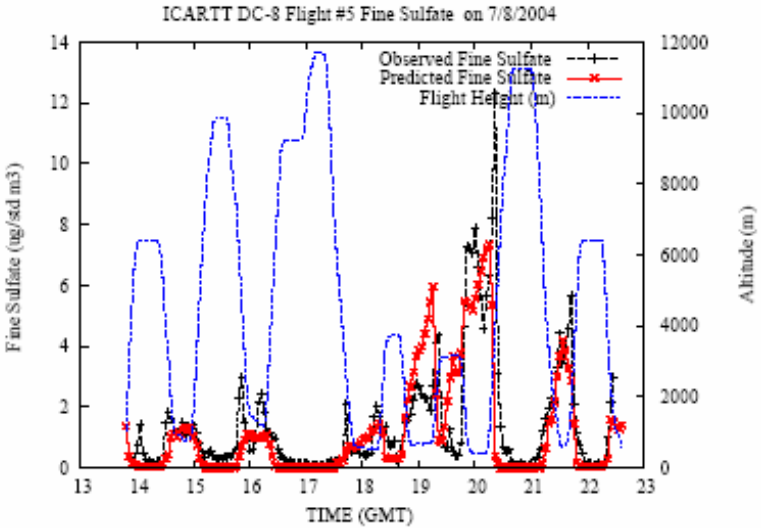
NASA INTEX DC-8 flight in July

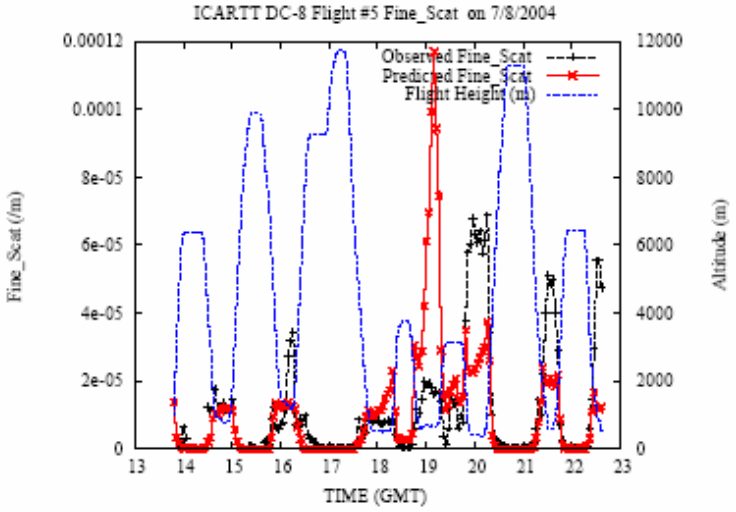


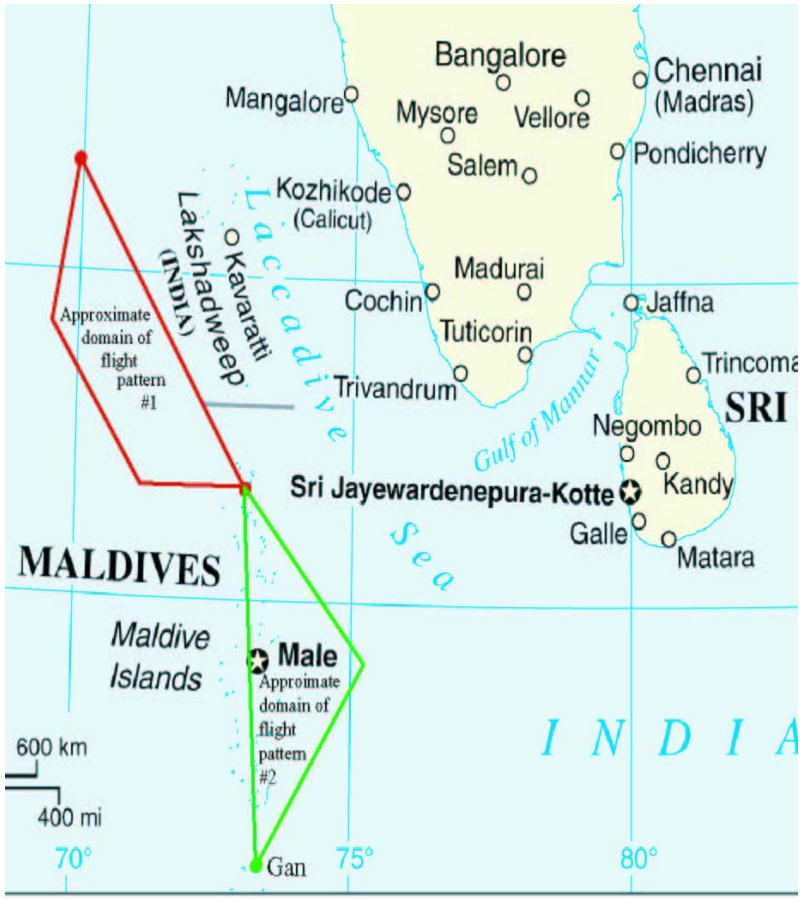
ICARTT/INTEX-A DC-8 flight 7 on 07/08/2004

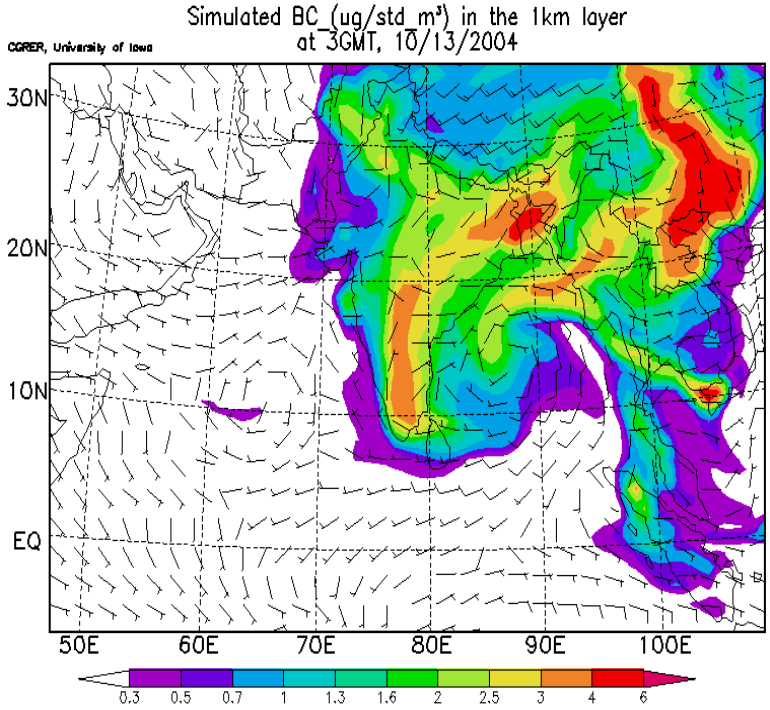
Sulfate is measured by Jack Dibb, University of New Hampshire, and aerosol optical properties are measured by Antony Clarke, University of Hawaii





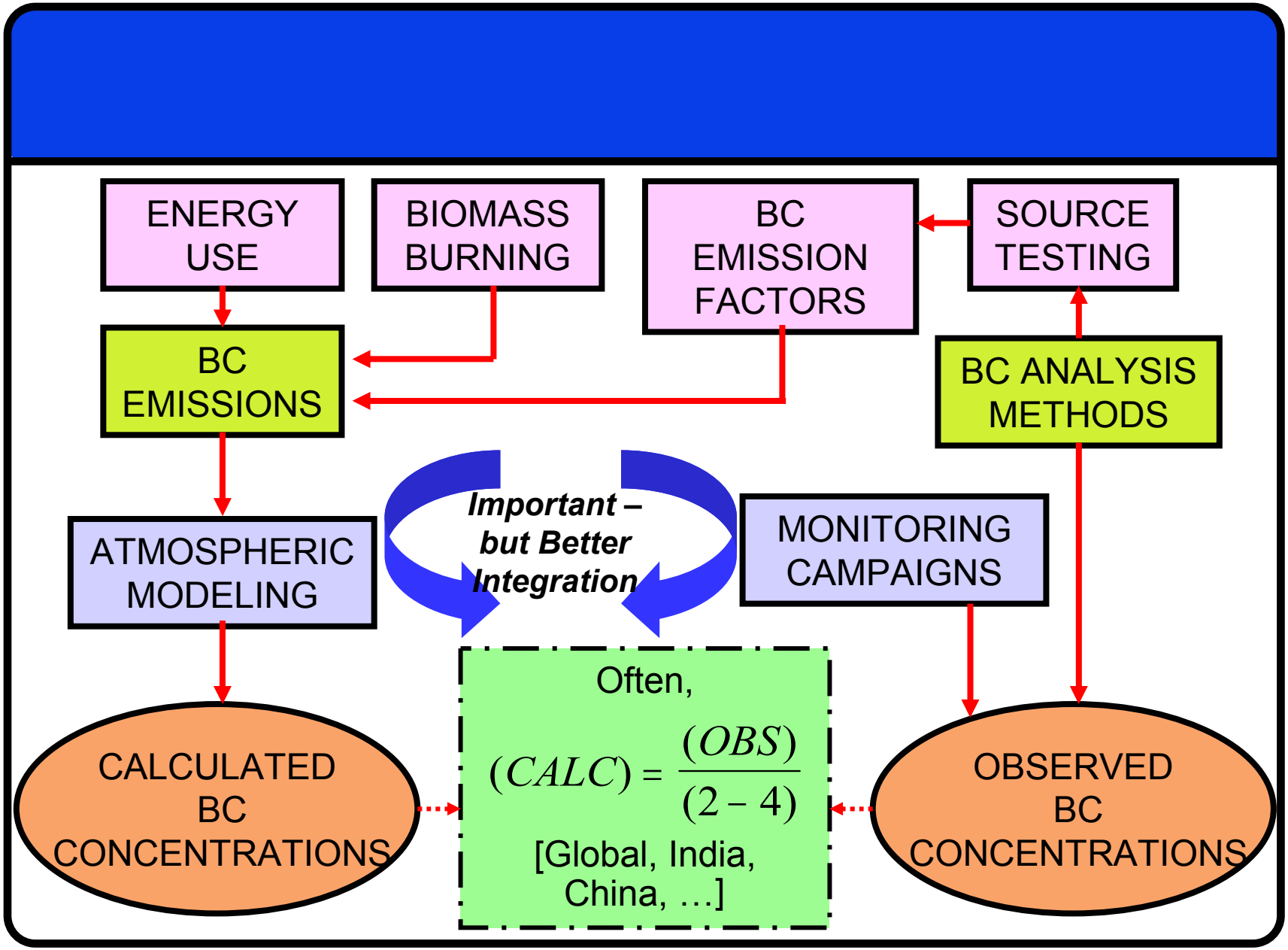






STEM Forecast Webpage for APMEX

http://nas.cgrer.uiowa.edu/ABC/abc-2k4.html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